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ABSTRACT

In the free banking period in the United States, banks issued private banknotes without discretionary restriction of entry into banking. Previous research suggests that specific aspects of the free banking laws account for banks' difficulties, losses to noteholders, and the attendant relatively large number of banks closed. In this paper, we examine the hypothesis that contagious bank runs explain why many banks closed. The evidence considered is: 1. the actual sequence of events in two episodes in which numerous banks closed; and 2. a statistical analysis of four episodes. The evidence is consistent with the hypothesis that contagious bank runs account for many of the banks closing. Bankers' use of measures such as restrictions of convertibility and joint guarantees was ad hoc and apparently less effective in this period than after the Civil War.

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I. INTRODUCTION

In recent years, theoretical and empirical research on relatively-unregulated banks have followed divergent paths. Beginning with Klein (1974), a theoretical literature has developed to characterize the equilibrium (or equilibria) of relatively unregulated banking. One aspect of this equilibrium which has received substantial attention is the set of circumstances that result in bank runs (Diamond and Dybvig 1983; Gorton 1985a; Waldo 1985). At the same time, analyses of instances of relatively unregulated banking suggest that bank runs were relatively unimportant (Rockoff 1974, 1975; King 1983; White 1984; Rolnick and Weber 1984, 1988).

The evidence presented in this paper indicates that bank runs and contagion effects associated with these runs are important for understanding the free banking period in the United States. The evidence we present is based on classic episodes when relatively large numbers of banks closed. We present two types of evidence: an historical analysis; and a statistical analysis. In the next section, we briefly review the pertinent aspects of free banking and present some data on the number of banks that closed in certain states. With this ground laid, we sketch the explanations for why banks closed. In the third section, we examine the events in two celebrated periods with substantial numbers of banks closing. In the fourth section, we present the results of a logit analysis which estimates the relative importance of various factors in explaining why banks closed. A brief conclusion follows.

II. FREE BANKING

In the years after the federal charter of the Second Bank of the United States was revoked in 1836, many states switched from special charters for each bank to free banking, a system in which a bank could be opened without discretionary legislative or regulatory approval. While a similar law was pending in New York, Michigan adopted a free banking law in 1837. In the following year, the legislature in New York adopted a free banking law which was widely copied in later years. The National Banking Act passed by Congress in 1863 signalled the end of this free banking era.

A. The Laws

A free bank could be established by any individual or groups of individuals.[1] There were minimum capital requirements to open a bank, and in order to issue notes, banks were required to deposit government bonds or mortgages with the state banking authority. Banks could circulate notes equal to the value of the bonds which, in general, were valued at the lesser of par value or market value. In most states, banks were required to keep specie as reserves in addition to bonds. If their reserves complied with the laws and they redeemed notes at par for specie on demand, banks received the interest on the government debt

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1 For individual states, Rockoff (1975, Appendix B) provides details on the security requirements of the laws and Hasan (1987, Chapter 2) provides details on these and other aspects of the laws in Indiana, Louisiana, New York, New Jersey, Virginia, and Wisconsin.

deposited with the state authority. Interest on these securities and interest from other securities and loans were the sources of revenue for the banks.

Notes of different banks were exchanged in the market at varying relative prices. Newspapers and "note detectors" provided information concerning the prices of bank notes and known counterfeits. To varying extents, state authorities provided periodic information on each bank's condition.

The free banking laws required banks to exchange specie for their notes at face (par) value on demand at one or more locations.[2] If a bank failed to redeem its notes at par on demand, the noteholder could send a notarized statement to the state banking authority (e.g. the state auditor) at the noteholder's expense. After the authority receiving the noteholders' protest of the failed redemption, the bank had a grace period of 3 days to 30 days in which it could redeem the notes. Commonly, interest accrued on the protested notes at annual rates of 5 to 20 percent. If a bank redeemed its notes after the authority's warning, then noteholders were not repaid the notary public's fee or any other expense of protesting the notes. If the bank failed to redeem its notes within the grace period, the banking authority could close the bank and dissolve it in addition to selling the bonds to redeem the notes.

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2 The inevitable breakdown of schemes such as par redemption is analyzed by Salant (1983).

B. Changes in the Number of Banks

At one time or another, 18 states had free banking. In this paper, we focus on three of these states: New York; Indiana; and Wisconsin. These states are used because data, which we use in the statistical analysis below, is available for individual banks. This is a sample of states with free banking that covers a wide range of experience. New York is widely regarded as an example of a relatively well-run banking system; the early years in Indiana are regarded as an example of wildcatting; and Wisconsin is a prime example of a state that shows the vulnerability of free banking to changes in the prices of bonds deposited with the state banking authority.

Table 1 summarizes the data on the number of banks in each state. It shows the total number of banks and the proportion of banks that closed during this period in each state. This includes banks that closed, whatever the reason. As a percent of the total number of banks that existed under free banking, New York had fewer banks close than the other states, but even in New York, about 35 percent of all free banks closed their doors by 1862. In Indiana, about 83 percent of the 104 free banks started between 1852 and 1861 did not survive to the passage of the National Banking Act in 1863.

Other than a few years which have large numbers of banks closing, free banking was not associated with a large number of banks closing. As Table 2 shows, the majority of banks that closed in New York did so in three periods: 1841 and 1842;

1853 to 1854; and the panic of 1857. Most of the banks that closed in Indiana did so in 1853, 1854, and 1857. Wisconsin had few banks close in any year but one: 1861. Substantial losses to noteholders occurred in 1853, 1854, and 1861. Rockoff (1975, pp. 17-22) estimates that noteholders lost about 7 percent of the value of notes issued by banks closed in Indiana in 1854 and 1855. Rolnick and Weber (1988) calculate annual rates of return on bank notes for Indiana, New York, and Wisconsin. They find annual loss rates for all bank notes of 7.5 and 5.0 percent in Indiana for 1853-54 and 1854-1855 and 11.8 percent in Wisconsin for 1861. As the proportion of banks closing would suggest, the magnitude of the ex post average loss rate is never very large for notes issued by all banks in New York.[3]

C. Why Did the Banks Close?

According to conventional wisdom 20 years ago, data such as the above provided evidence dramatically inconsistent with the smooth operation of relatively unregulated banking (e.g., Hammond 1957, Chs. 18, 19). The period was said to be one of "wildcat banking" in which banks were opened where the wildcats roamed. These alleged remote locations postponed redemption of the notes issued by a bank long enough that bankers could make a quick capital gain by issuing notes and then closing the bank, maybe even opening another one elsewhere. Rockoff (1974, 1975) and Rolnick and Weber (1983) show that this colorful character-

3 King's (1983) estimates are similar.

ization, while it can be entertaining, easily can be overstated.[4] Their results indicate that banking in this period was not as disruptive as the historical narratives suggest.

Par versus market valuation of bonds

How could a one-time gain from opening a wildcat bank have arisen?[5] Suppose that the organizer of a bank has $10,000 (for convenience) and wants to start a bank. He can use the $10,000 to buy bonds with a market value of $9,000 and $1,000 of specie for redemption. After depositing the bonds with the banking authority, the organizer receives notes which he then passes out in loans. The resulting balance sheet is the one given in the t-account in Table 3 for the "Sound Bank". The return from operating this bank is the interest on the bonds and loans, interest which is received by the organizer only if the bank continues in operation. An advantage of operating the bank is the leverage implicit in the notes and loans.

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4 Hammond (1957, 627-630) does not really believe it characterizes the majority of banks and is partly summarizing the previous literature.

5 As part of his work, Rockoff (1975, p. 8) points out that wildcat banking, when it existed, reflected a one-time gain from opening a bank. Rockoff (1975, p. 5) defines a "wildcat bank" as "a bank that issued notes in a much greater volume than it could continuously redeem, and that came into being as a result of a liberal entry provision in a free banking law". (Emphasis in the original.) The first part of the definition borders on a definition of wildcat banking as "imprudent" banking. As a result, using his definition, Rockoff includes gains from interest received for an ongoing bank, while we do not.

For their empirical analysis, Rolnick and Weber (1984, p. 276) define a wildcat bank as one which failed in its first year of operation and resulted in losses for noteholders.

This leverage is not related to wildcat banking in any interesting way. It is easy to see how a bank can be very highly leveraged. The organizer can loan the notes to himself and use these notes to buy more bonds, which are then redeposited with the banking authority for more notes. The organizer of such a bank is highly leveraged since only $10,000 of his funds are used by the bank. This does not necessarily show up in the balance sheet. The various ratios of assets to liabilities are the same for the "Leveraged Bank" in Table 3 as for the "Sound Bank." This process could continue until the value of the bonds and notes is quite large relative to the initial $10,000 used to organize the bank and the value of the loans is quite large relative to the assets of the organizer of the bank, who is after all liable for the loans made by the bank to himself. This strategy yields a higher rate of return than a less leveraged operation <u>if the bank continues in operation</u>. The organizer gets the interest on the bonds as long as the bank continues in operation. If the bank closes before collecting interest, perhaps because of a failure to redeem notes on some day, the organizer of the bank gains nothing. The bonds are sold and the noteholders are paid from these proceeds. If the value of bonds has not fallen, the organizer of the bank gets his $10,000 back. A highly-leveraged operation is a high return strategy as long as the bank continues in operation. It does not seem useful to lump together a highly-leveraged operation and one which produces a clear one-time capital gain upon opening.

A one-time gain clearly was possible if, for purposes of issuing notes, bonds were valued at par and par was less than market. If bonds were valued at par for issuing notes and the market value of the bonds were half the par value, then $10,000 could be used to buy bonds and $20,000 of notes could be issued. These notes could then be used to buy more bonds, and so on.[6] The first pass with $10,000 is shown in Table 3 for the "Wildcat Bank. From this table, it is clear that $10,000 has been turned into $20,000 and there is a $10,000 gain from starting the bank. This gain accrues on the day the bank is opened and will not recur. Under these circumstances, a possible strategy for the organizer is to make a "loan" of the notes to himself and leave town. It is arguable that awareness of this possible strategy is the reason that, after a little experience with free banking, free banking laws required valuation of bonds at the lesser of par or market. (Rockoff 1975, Appendix B). Rockoff (1975, pp. 98-114) presents some discussion of historical instances consistent with this hypothesis.

Declining values of bonds

An alternative explanation for the large number of banks that closed during the free banking period is even simpler: banks failed when the value of their assets declined. For exam-

6 Alternatively, one could just borrow the funds to buy the bonds and get the gain all at once. The incentive clearly is to do this, because issuing notes at par under such circumstances is not an equilibrium and therefore is not likely to persist. For an example of the equilibrium with notes valued as if they were shares in a mutual fund, see Rolnick and Weber (1988).

ple, with the onset of the Civil War, the prices of bonds issued by Southern and Border states fell by about a third. This exogenous decline in the value of assets inevitably erodes the capital of a bank and increases the likelihood of failure. Most of the bonds held by banks in Wisconsin and Illinois were issued by these states, and it has long been thought that decreases in the prices of bonds were the major reason for many banks closing in the early 1860s in Illinois and Wisconsin. (Dowrie 1913; Merk 1913; Krueger 1933). Rolnick and Weber (1984) suggest that this explanation holds more generally and that a serious defect of the free banking system was the use of long-term bonds with large fluctuations in their prices to back notes issued with a constant redemption value. They also present some evidence consistent with this hypothesis.[7]

Contagion effects and runs

A different alternative suggested by recent theoretical work and histories of banking after the Civil War, e.g. Friedman and Schwartz (1963), is that contagion effects and bank runs resulted in these fractional-reserve institutions closing. Suppose noteholders have imperfect information on a bank's assets and activities and whether a bank is solvent. Exogenous events such as incidents of wildcat banking, declining asset prices, or the closing of another bank could induce noteholders to return

7 Economopolous (1985, 1986) finds evidence consistent with the hypothesis that free banks in states with higher required reserves of specie relative to deposits were less likely to fail.

notes to a bank for redemption in specie, even if the bank is otherwise solvent.[8] Because they are fractional reserve institutions, banks generally cannot convert all of their assets into specie instantaneously. As a result, otherwise solvent banks are forced to suspend the convertibility of notes into specie and in some cases eventually close.

If contagion effects due to imperfect information are important, bankers have an incentive to provide information that reduces the effects of any informational asymmetries that may exist. This can take the form of attempts to jointly certify or even guarantee other banks' liabilities, which would have information value beyond a bald assertion by an individual bank. In the national banking period, actions by clearinghouses including joint restrictions of convertibility have been interpreted as such attempts at joint action by Timberlake (1984), Gorton (1985a; 1985b), and Dwyer and Gilbert (1989). In Gorton's analysis, restriction of convertibility of deposits is interpreted as a signal of the suspended banks' ultimate solvency.

III. TWO MAJOR EPISODES WITH NUMEROUS BANKS CLOSING

How important are these various factors in explaining banks closing? We evaluate the hypotheses two ways: 1. in

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8 Gorton (1985a) provides a clean analysis of runs on a single bank and how a temporary restriction of convertibility might be interpreted as evidence that the bank expects to be able to redeem at par in the future. As Postlewaite and Vives (1987, p. 489) note, Diamond and Dybvig's (1983) model can be interpreted in terms of this hypothesis.

this section, an examination of events in two episodes; and 2. in the next section, a statistical analysis of data for four episodes.

We focus on two of the periods identified in the last section which had numerous bank failures. The first period, Indiana in 1854, is one in which wildcatting is supposed to have been very important. (Esarey 1913, pp. 282-85; Rockoff 1975, pp. 98-100). More recently, Rolnick and Weber (1984, p. 288) suggest that falling bond prices explain why the banks closed. The second period, Wisconsin in 1861, is one in which falling bond prices long have been identified as the culprit (Merk 1916, Ch. VII).[9]

A. Indiana - - 1854

In Indiana, the free banking act was approved in May 1852 and banking activities really started in 1853. Twenty-eight banks closed in 1853 and 27 closed in 1854. Wildcat banking and falling prices of bonds valued at par by the state auditor have been alleged as the important causes of these closings (Rockoff 1975, pp. 98-100; Rolnick and Weber 1984, p. 288). The evidence for 1854 points in a quite different direction. It points to a contraction of the banking system, one which created substantial problems for the relatively new banks in Indiana.

In 1854, there was a drain of specie from the banking system. The total amount of specie held by banks in the United

9 Calomiris and Schweikart (1988) discuss the run in 1857 in New York.

States toward the end of 1854 was about $54 million, which is less than the $59 million held a year earlier (Comptroller of the Currency 1877, p. XCIV)[10]. There are at least two alternative explanations for this decrease: 1. an increase in the demand for specie abroad related to the Crimean War (Esarey 1913, p. 283; Myers 1931, pp. 139-41); and 2. an increase in the demand for specie by the nonbank public in Western states (Smith and Cole 1935, pp. 128, 135).

Whether the drain of specie was external, internal, or both, the result was a contraction of banks' notes and deposits in the United States from $205 million in 1853 to $187 million in 1854. (Comptroller of Currency, 1877, p. XCV). According to Banker's Magazine (November 1854, p. 493),

> The past months have been productive of more failures among banks and bankers than any months since the memorable year 1837. A panic seized upon the community in the Western cities, and bank circulation was so suddenly returned and deposit [sic] withdrawn, that many were compelled to suspend. Among these were banks of long established credit and abundant means.

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10 Unfortunately, only incomplete data are available for 1852 and the summary data for the United States are not available at all for 1851. Smith and Cole (1935, pp. 116-21) present summary data for selected states with data available in all years at about the same time of year. Their data indicate that specie held by banks in four Eastern states did not fall in any year from 1851 to 1855. Bank notes rose from $69 million in 1852 to $81 million in 1853 and then fell to $78 million in 1854 and $77 million in 1855. Specie held by banks in seven Southern and Western states, not including Indiana, rose from about $19 million in 1852 to $20 million in 1853, then fell to $18 million in 1854 and rose to $24 million in 1855. These banks' notes followed a similar path, increasing from $47 million in 1852 to $55 million in 1853, decreasing to $43 million in 1854, and increasing to $54 million in 1855.

Banks in Indiana, Illinois, and Ohio suspended specie payments. The process that led to these suspensions was described by the Auditor for Indiana (the banking regulator in that state) in late 1854:

> [f]rom about the first of May, last, from several relative causes, a heavy run commenced upon the State Stock Banks of Indiana, for coin. The scarcity and demand for Eastern Exchange, which yielded a sufficient profit to the Brokers of our neighboring cities to induce them to collect and assort the notes of our banks, and to send them home in large sums for redemption in coin, caused such a drain upon their specie as to give them great trouble to keep an adequate supply on hand. So inveterate was the demand for <u>coin</u> and nothing but coin, that many of the banks which had provided themselves with Eastern Exchange, and offered it to those who presented large amounts of their paper, were told in reply, that the notes promised to pay dollars, and that nothing would be taken instead therof. This unprecedented, and almost unheard of run, continued to increase for more than sixty days, before any one of those banks declined to furnish to the numerous bands of brokers and bankers, who continued to assort and send home their paper, the heavy sums demanded by them in specie.
>
> .... A general depreciation ensued. Those banks which continued through all the pressure that was made upon them, to redeem in coin, were alike discredited with those which had refused to pay to brokers, bankers, and their agents. ... [C]apitalists could not be found, who were able and willing to protect the paper to purchase the State bonds which secured it, unless they were sold at unreasonable depreciation and loss. (Auditor of State, Indiana, <u>Annual Report, 1854</u>)

The sequence of events summarized by the Auditor is a drain of specie from the banks to the nonbank public which originated in Ohio. In early 1854, much of the currency in Ohio

was Indiana banknotes, and only one chartered bank in the major trading center and port in Ohio, Cincinnati, issued currency.[11] This state of affairs was the result of the imposition of property taxes in Ohio on banks' assets and liabilities. On May 1, 1854, the Ohio Legislature passed a law which made it illegal after October 1 for any individual in Ohio to use small foreign banknotes (banknotes issued by banks with a charter from any other state) other than to return them out of state. The penalty for violating this law was a fine of $100 and, in the case of a bank, revocation of its charter. On August 21, bankers in Cincinnati met and decided on a schedule for returning banknotes to smooth the transition to the complete elimination of foreign notes on October 1.[12] All banknotes issued by Indiana banks were to be no longer treated as current by September 20. As a result of this decrease in the demand for Indiana notes, these notes were returned to the Indiana banks and, given the law, the demand was for specie to replace the notes. This demand was sufficiently large that, despite planning for the expulsion of the foreign notes, two or three private banks in Cincinnati

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11 The estimate is given by Richard Smith, the Superintendent of The Merchants' Exchange in Cincinnati, in Hunts' Merchants' Magazine (November 1854, p. 615). The issuance of currency in Cincinnati is mentioned in a discussion in Bankers' Magazine (February 1854, p. 684) of an article in the Cincinnati Commercial. A detailed account of Ohio banking in this period is given by Huntington (1915, Chs. X, XI, XII).

12 Bankers' Magazine (November 1854, pp. 339-43) contains a summary of the bill, an editorial on the matter from the Cincinnati Gazette, and the Cincinnati bankers' resolution.

restricted specie payments in September (Bankers' Magazine November 1854, p. 406).

Evidence on the date of the decline in the value of bonds also is consistent with the Auditor's description of events. About two-thirds of all the bonds held by Indiana banks were Indiana 5 percent bonds (Auditor of State, Indiana, 1853, p. 42). In June, July, and August, the prices of Indiana 5s were 100, 97-1/2 and 96 percent of par. The prices fell roughly 10 percent in each of the next two months. On September 25, 1854, the offer price was 88 percent of par, and on October 23, the offer price was 79-1/2. These decreases in the value of Indiana bonds are after the drain of specie had started.

This decrease in the price of the Indiana bonds was a change in the price of Indiana bonds relative to the prices of United States bonds. For 1850 to 1857, Figure 1 shows monthly data on the prices of Indiana 5s relative to the price of United States 6s due in 1867-68. While the offer price for Indiana 5s fell about 8.3 percent in September 1854, the offer price for United States government 6 percents rose about 1.1 percent. In the next month, when the price of Indiana 5s fell 11.8 percent, the offer price of the United States government securities rose about .2 percent. There is no evidence of any development concerning Indiana's fiscal affairs or payments on its debt that would decrease the price of the bonds.[13] It is possible, of

13 Esarey (1918, Ch. XVI) presents a detailed history of the debt. Negative statements such as the one in the text are hard to state uncategorically. Nonetheless, neither the two volumes by Esarey, nor Hunt's Merchants' Magazine, nor Bankers' Magazine, nor the governor's report on the finances of the state for the year ending October 31, 1854 (Bankers' Magazine April 1855, pp. 765-66) provides any evidence of any fiscal problems that the state had in 1854.

course, that the price in 1853 and 1854 was higher because Indiana banks held $2.3 million of Indiana's total debt of about $7.7 million, and the increase in demand raised the price of the bonds.[14]

This decrease in Indiana bond prices came after the drain of specie and the run on banks had begun. It is quite implausible that the decrease in bond prices in August 1854 caused an increased demand for specie earlier in the year.

Besides bond prices, valuation of the bonds at a par value greater than the market price is an alleged reason for banks issuing notes that were never likely to be redeemed (Rockoff 1975, p. 100). There is an element of truth in this, because the Auditor apparently did accept most bonds at par value. The Auditor's Annual Report for 1853 (pp. 42-43), though, clearly shows that not all bonds were accepted at par. Indiana bonds with a coupon rate of 2 - 1/2 percent were accepted at half of par and California bonds were accepted at two-thirds of par. Other bonds were accepted at par, but this is not surprising because the law specified that bonds be valued at the lesser of par or market, and the market price generally was greater than par. In this period, the prices of Indiana 5 percent bonds were

14 As Figure 1 shows, the price of Indiana bonds rose relative to the price of United States bonds in 1852 and then fell in the last months of 1854. Part of the rise in the price is due to a change in the way interest was paid. Before 1853, one-fifth of the interest on the bonds was paid in bonds on which interest would not be paid until 1853. In 1853, Indiana began paying all of the promised interest.

such that acceptance at par was consistent with market valuation. In 1853, the prices of Indiana 5 percent bonds were 102 percent of par at the start of the year and 98 percent of par at the end of the year. (Banker's Magazine February 1854, pp. 616-617.) The lowest price at the start of any month in 1853 was 97.5 percent of par value in both April and December. Two-and-a-half percent below par is not a large deviation from par: in early 1853 and even in June of 1854, the market value was two percent above par.

If sound banks "were alike discredited with those which had refused to pay" specie in exchange for notes, bankers had an incentive to mitigate the situation by joint actions. On October 20, "quite a number of free bankers assembled" in Indianapolis and suggested that 5 percent of the Indiana banks circulation be called in.[15] In December, representatives of 31 banks met in Indianapolis and issued a report on the banks' and the stockholders' financial condition (the stockholders were personally liable up to an amount equal to the amount of capital in the bank). To dispel misinformation, the report also stated that these banks "notwithstanding all the reports abroad, of general suspension, have never, at any time, refused to redeem their issue in coin." (Hunt's Merchants' Magazine January 1855, p. 109) [16]

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15 The account of this meeting in the Indianapolis Journal is quoted in Bankers' Magazine (November 1854, p. 403).

16 If there were no reports abroad of a general suspension, the banks certainly did not have an incentive to state that there were such reports, because such a statement could only raise fears that such a suspension was imminent.

Wisconsin - - 1861

The closing of about 47 percent of Wisconsin banks in 1861 seems to be a clear instance of falling bond prices resulting in a substantial number of banks closing.[17] At the start of 1860, the bonds of Southern and Border states were more than 70 percent of the backing for notes issued by banks in Wisconsin. Bonds issued by the state of Missouri alone were about 40 percent of the total value of bonds deposited. Figure 2 shows weekly data on the prices of United States, Virginia, and Missouri bonds in 1860 and 1861.[18] The prices of bonds issued by Southern and Border states decreased in late 1860 and in 1861 as war became imminent. The prices of these bonds fell after the election in 1860 and fell dramatically in April 1861 with Beauregard's shelling of Fort Sumter, an action which was followed by Lincoln's call for troops and his order that Southern ports be blockaded. Prices of the Southern and Border states' bonds fell relative to the prices of United States bonds, which also fell, and even more relative to the prices of some Northern states' bonds.

As the Bank Commissioner for Wisconsin pointed out in 1860, Missouri bonds were such a large fraction of the banks'

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17 The following account primarily relies on Merk (1913, Ch. VII), Krueger (1933, Ch. IV), Eaton (1954), and Simkins and Roland (1972, Chs. XIV and XV).

18 Bond prices for Georgia, Louisiana, North Carolina, and Tennessee generally are similar to the Virginia bonds. We chose the 6 percent Virginia bonds because prices are available for all of the weeks in April 1861, the month when the largest part of the decrease in bond prices occurred.

bond holdings because bonds were valued at the lesser of par or market.[19] During the late 1850s, many bonds had 6 percent coupons and sold at a premium. This created an incentive for banks to use lower-valued, riskier bonds as collateral for their notes because the premium over par could not be used as backing for notes issued. This is the antithesis of Rockoff's conclusion (1975, pp. 104-107), based on a Congressional report in 1855, that Missouri bonds were a large part of the backing because the Bank Controller took Missouri bonds at par.[20]

The falling bond prices were followed by actions and reactions by the Bank Commissioner, bankers, and Wisconsin legislators. In October and November 1860, and in early February 1861, the Wisconsin Bank Commissioner ordered banks to adjust their bond accounts or notes to offset the depreciation of the bonds. On February 15, 1861, the state legislature postponed until April the third call for adjustment. The end of the postponement was quickly followed by an announcement on April 4 by Chicago bankers that they would not accept the notes of 40 of the 107 Wisconsin banks. The next day, a meeting of Wisconsin bankers produced a declaration that Wisconsin bankers would not accept the notes of 19 banks until the banks brought the backing for their notes up to 95 percent of the value of the notes. On

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19 The observation by the Bank Controller is on page 7 of his Report for 1860 and is quoted by Merk (1913, pp. 190-191).

20 Of course, this does not imply bonds should have been valued at par. As the Wisconsin Bank Commissioner suggested, valuation of bonds at market might have been a better rule.

April 17, the legislature passed a law which stopped, until December, notary publics from notarizing protests of banknotes and the Bank Commissioner from redeeming protested notes. This suspended the requirement that banks convert notes into specie at par in the same week that, for example, the price of Missouri bonds fell from 58.25 percent of par to 39.75 percent of par. A second bankers' meeting was held on April 25 at which the bankers declared that they would not accept the notes of 18 more banks. At this meeting, the bankers also declared they would accept the notes of all other banks at par until December 1, 1861.

As it turned out, the banks did not keep their commitment to take all other Wisconsin banks' notes at par. On June 3, the Bank Commissioner made an additional call on banks to adjust their bond accounts or notes. Eighteen of the banks with notes accepted at par failed to adjust their bond accounts and 10 of these closed shortly afterwards. At this point, Milwaukee bankers met and agreed to accept the notes of these 10 banks "on special deposit." There was a riot the next day in which a mob wrecked two banks.[21]

The evidence of a run on the banking system is clear: on April 17, convertibility of notes into specie was suspended for all banks. The evidence of contagion effects of necessity

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21 The announcement concerning these 10 banks was delayed for one day, apparently until many Milwaukee workers had been paid with notes from these 10 banks.

must be indirect. This evidence is: 1. the restriction of convertibility for all banks, even though bonds were a small part of some banks' assets; and 2. the guarantee by the bankers of other banks' notes. One purpose of guaranteeing acceptance of other banks' notes at par was to jointly certify the notes of the other banks and thereby each bank's own notes, an action which provided some noteholders with backing from the apparently solvent banks in the system.

IV. STATISTICAL ANALYSIS

While these accounts are informative, they usefully can be supplemented by statistical evidence on the relative importance of various factors. It is entirely possible that all of the banks which permanently closed were the ones that would have closed anyway. In this section, we present the results of a logit analysis for Indiana, New York, and Wisconsin. We focus on the periods with large numbers of banks closing. Because of the spottiness of the available data, it is not possible to do an analysis of data for every year. The time periods used are 1841 and 1842 for New York, 1854 for New York and Indiana, and 1861 for Wisconsin. The sources for banking data are mainly state banking authorities' reports and reprints of them by the United States Congress.[22] We use the latest reports of the banking authorities before these periods. Bank closed at the

22 The details on the sources of the data are presented in the Data Appendix.

end of the period are classified as closed banks and other banks are classified as surviving banks.[23]

A. Estimation procedure and variables

To estimate the relative importance of different explanations of why banks closed, we estimate the parameters of the logit function:

$$P_i = \frac{1}{1 + \exp(-X_i \beta')}$$

where P_i is the probability of the i'th bank closing in the episode, X_i is the one by k vector of observations of the right-hand-side variables for the i'th bank, and β is the one by k vector of parameters. One of the variables in the vector X_i is a one, thereby permitting the analogue of the intercept to be estimated. This probability, P_i, is unobserved, but the outcome for each of the n banks, y_i, either closing ($y_i = 1$) or surviving ($y_i = 0$), is observed. The parameter vector is estimated by maximizing the likelihood function

$$L = \pi P_i^{y_i} (1 - P_i)^{y_i}$$

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23 We do not distinguish between banks that closed with their notes at least eventually redeemed at par and banks that closed with their notes redeemed at less than par. With the exception of Wisconsin, the results in Hasan (1987, Chapter III) indicate that the distributions of various measures of banks' portfolio holdings do not differ significantly across banks that closed at par and below par.

and the statistical significance of coefficients is tested by a Wald test statistic, which is asymptotically chi-square.[24] While asymptotic tests are suspect for some of our sample sizes, logit estimates do constrain the estimated values of the left-hand-side variable to the interval bounded by zero and one.

Basically, there are three hypotheses tested concerning why banks closed. The hypotheses tested are that the probability that a bank closed is related to: 1. the value of bonds declining in value relative to capital; 2. the remoteness of its location; and 3. contagion effects of other banks closing.

Declining values of bonds

We measure the importance of declining bonds by the ratio of the value of declining or defaulted bonds to capital held by the bank. We do not have data on individual bank's holdings of various securities for New York in 1854. As a result, this variable is not included in this equation. The discussion above of Indiana in 1854 and the statistical analysis below suggest this is not a serious omission.

As the Indiana auditor suggests, sales of bonds due to dissolution of banks may have temporarily affected bond prices. When a bank closed, its bonds were sold, which could lower the price of the bonds. This decline in the value of bonds could adversely affect the assets of other banks and make it more likely that other banks would close. This effect of bond sales

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24 The fundamentals of the statistical analysis are presented in Fomby, Hill, and Johnson (1984, pp. 339-52, pp. 612-13).

on bond prices is an endogenous part of the process of banks closing and is not the same as the hypothesis that exogenous decreases in bond prices increased the likelihood of banks closing. In terms of a test of the hypothesis that an exogenous decrease in bond prices increased the probability that a bank would close, the endogenous decrease in bond prices, if important, biases the coefficient of this variable to be consistent with the hypothesis that decreasing bond prices affect the probability of a bank closing. This bias reinforces the exogenous effect.

Remote Locations

A consistent theme in the historical literature is the association of remote locations and the issuance of notes in excess of amounts consistent with prudent operations. Indeed, this was the basis for changing laws about permissible locations, for example in Indiana in 1855 (Hammond 1957, p. 621). As the analysis of Indiana and Wisconsin above indicates, the evidence is inconsistent with the hypothesis of valuation of bonds at par. If wildcatting, which can be defined as issuing notes with the expectation of closing the bank shortly, was not going on, why would remote locations be associated with a higher probability of banks closing?

A remote location may well be related to the probability of the bank closing if the cost of information about a bank is related to such locations. One way of thinking about a "remote location" is in terms of its distance from the nearest redemp-

tion center.[25] Noteholders could protest their notes at redemption centers if a free bank refused to redeem the notes in specie. These centers were usually located in the capital city of the state and in other cities, where free banks generally were required to have agents. Dealers in the secondary market for notes were located in these cities also, as were the major newspapers. Other than at its home office, any information on the bank's condition and any protest of its notes would have been first known in these cities. It was the state banking authority's office which handled noteholders' protests, complaints, and bankers' explanations before deciding on closing a bank. After a protest by a noteholder, it took at least a few weeks before any verdict was given by the authority's office. In a time when communication was slower, customers in distant areas did not have instant information on their local banks. If a local bank refused to redeem its notes for specie and it was far from the redemption centers, the cost of protesting the notes was higher for the noteholders. These considerations suggest that the imperfect informational necessary for contagious bank runs was greater the further a bank was from the nearest

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25 Another way of thinking about a remote location is in terms of the size of the city or town in which the bank is located. We attempted to distinguish between the two by including urbanization, measured by population density in the county, in the equations in addition to distance from the redemption center. Distance from the nearest redemption center and population density are sufficiently highly correlated that it is not possible to distinguish between the two. The results with either distance to the nearest redemption center or population density are quite similar.

redemption center. This implies that, if distance from a redemption center is associated with the greater likelihood of a bank run, distance can be positively related to the probability of a bank closing. In the equations, distance from the nearest redemption center is measured in terms of its logarithm because initial estimates indicated that the logarithm of distance is more closely related to the dependent variable than distance entered linearly.

Contagion effects

We assume that, if contagion effects associated with bank runs are important, then this shows up as an increased probability of a bank closing if another bank in the county closed. This variable is measured as a dummy variable, which is one if another bank closed within the county and zero otherwise.[26] Under the hypothesis of contagion, this coefficient is positive. If the probability of a bank closing is independent of the closing of other banks, this coefficient is zero because the dummy variable for a particular bank is constructed in such a way that it is independent of whether this particular bank closed.

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26 An example may be helpful. Suppose there are two banks in a county, Bank A which closes and Bank B which stays open. The dummy variable for contagion is 0 for Bank A, because Bank B did not close, and 1 for Bank B, because Bank A did close. If Bank A did not close, the dummy variable for Bank A still would be 0, because all that matters is that Bank B did not close.

B. Empirical results

Table 4 shows the results of estimating the equation for each of the episodes and for all of the episodes combined. Besides the coefficients and their standard errors, Table 4 presents the marginal significance level of each coefficient and the marginal probability associated with each variable. Since the equation is nonlinear, the effect of a change in an independent variable on the probability of closing cannot be assessed immediately from the estimated coefficients. Each of the numbers denoted "mp" or "marginal probability" is the partial derivative of the probability of a bank closing with respect to a right-hand-side variable, with the change evaluated at the mean value of the right-hand-side variable.[27] For each equation, the table also includes the over-all chi-square value for the right-hand-side variables (other than the intercept) and its marginal significance level. For convenience, the number of observations and -2 times the logarithm of the likelihood function also are included. All of the equations in Table 4 are easily statistically significant at the usual five percent significance level. The last row of the table shows the estimated equation under the hypothesis that all of the coefficients are the same for the states with data on bank's bond holdings. This hypothesis, though, is inconsistent with the data. The chi-

27 "Marginal probability" is the customary term and is convenient, but these are not "marginal probabilities" in the distributional sense and can be negative or greater than one.

square statistic for testing the hypothesis that all of the coefficients are the same is 24.44 with 8 degrees of freedom, which has a marginal significance level of .002.

The ratio of bonds that declined in value relative to capital has a statistically significant coefficient at any usual significance level only in Wisconsin in 1861. The marginal significance levels are only about 60 percent for New York in 1841 to 1842 and 45 percent for Indiana in 1854. Evaluated at the mean, an increase in the ratio of declining bonds to capital by 10 percentage points increases the probability of a bank closing by 25 percentage points in Wisconsin.[28] This indicates that declining bonds had a substantial effect on the likelihood that a bank would close in this episode, a result that is quite consistent with the historical accounts and the data on bond prices. Consistent with the historical analysis above, declining bond prices are not important in explaining which banks closed in Indiana in 1854.

Distance to redemption center is important in most of these episodes. In Indiana, the marginal significance level is only 38 percent but in each of the other episodes, the coefficient of this variable is statistically significant at the 6.5 percent marginal significance level or less. The values of the marginal probabilities suggest that greater distances to redemp-

28 Since this effect is so large, it is worth emphasizing that this partial derivative is evaluated at the mean values of the variables and is a decreasing function of the ratio of declining bonds to capital after an initial inflection point.

tion centers are associated with important differences in the likelihood of a bank closing in some cases. Because distance is entered into the equation in logarithms, there is not a natural interpretation of the marginal probabilities, but the numbers are large. For example, in Indiana, evaluated at the mean, the probability that a bank will close increases 8.4 percentage points with an increase in distance by 10 miles from the geometric mean of 66.6 miles. In Wisconsin in 1861, the marginal probability of a bank closing is 2.7 percent with an increase in distance by 10 miles from the geometric mean of 31.2 miles.

The closing of another bank in the county is important in all four of the episodes. In New York in 1841 and 1842 and in Indiana in 1854, the estimated coefficients of the dummy variable for another bank closing in the county are statistically significant at the .04 and 1.9 percent significance levels. In New York in 1854 and in Wisconsin in 1861, the estimated coefficients are statistically significant at the 5.9 and 12.4 percent significance levels. In New York in 1841-42 and in Indiana in 1854, the associated marginal probabilities are substantial. As is clear from Table 5, the probability of a bank closing is in every case substantially affected by the closing of another bank in the county. Even in New York in 1854, when the probability of a bank closing is smallest, at the mean distance from a redemption center, the probability of a bank closing increases from about 4 percent to about 10 percent if another bank in the county closes. Given the low probability of closing, even this is a substantial effect.

V. CONCLUSION

The contemporary accounts and the statistical evidence both support the hypothesis that contagious bank runs were a significant factor contributing to the number of banks which closed in the free banking period. The evidence indicates that the runs were precipitated by events exogenous to the banking system. In Indiana in 1854, the expulsion of Indiana's notes from Ohio by law shortly after the startup of the banking system is the main ingredient in the episode. In Wisconsin in 1861, the decrease in bond prices lowered the value of the banks' assets and began a substantial contraction of the banking system. A general restriction of the convertibility of notes into specie followed rather quickly.

Our results also suggest more congruence between the experience in the National Banking period as discussed by Friedman and Schwartz (1963) than recent empirical work on free banking would suggest. It is worth noting that such a conclusion does not imply that the free banking system worked badly relative to possible alternatives.

Our results highlight the role of certification of soundness and the role of restrictions in runs. In particular, the attempts by Indiana and Wisconsin bankers to sort out the sound and failed banks have some of the same characters of clearinghouses' certification of banks during restrictions of convertibility in the last half of the 19th century. We think that the adequacy of such private institutions as a substitute

for a central bank supported by the government is an open question, one that is worth pursuing along lines started by Timberlake (1984) and Gorton (1985b). These issues are as important for understanding free banking as for understanding the last half of the 19th century and, ultimately, the characteristics of banking without a lender of last resort.

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Data Appendix

A. Banking Variables

New York

The data on the number of banks are based on: 1. House Documents, U.S. Congress, 1838-1863; 2. Economopolous (1985); and 3. Dillistin (1946).

Data on the banks' balance sheets in the 1840s primarily are from House Document No. 111, 26th Congress, 2nd Session, (November 1840) pp. 166-67. Data on bank capital are from House Document No. 172, 26th Congress, 1st Session, (January 1840) pp. 166-67. Bonds issued by states that defaulted on their debt are used to estimate the bonds that declined in value. Ratchford (1941, pp. 96-100) indicates that 4 states defaulted in 1841 and 5 more in 1842. The banks included in the analysis are those which appear in the 1840 report. If a bank appears in the 1840 report, it is classified as surviving if it appears in the 1842 report as well. Otherwise, a bank that appears in the 1840 report is classified as closed.

Data on the banks' balance sheets in the analysis of 1854 are from House Document No. 102, 33rd Congress, 1st Session, (January 1854) pp. 92-127. If a bank appears in the 1853 report and in the report at the end of 1854, it is classified as surviving. Otherwise, a bank that appears in the 1853 report is classified as closed.

Indiana

The data on the number of banks are from: 1. the Annual Report of the Auditor of State, 1852-1863; 2. House Documents, U.S.

Congress, 1853-1863; 3. Economopolous (1985); and 4. Rolnick and Weber (1982). Data on the banks' balance sheets are from the Annual Report of the Auditor of State of December 1853, pp. 129-31 and House Document No. 102, 33rd Congress, 1st Session, (February 1854) p. 172. Indiana bonds are assumed to be the bonds held by the banks which declined in value. The auditor's report of December 1853 includes 29 banks and is the only detailed report prior to 1854. If a bank appears in the 1853 report and is included in the report for 1854 as an existing and open bank, then a bank is classified as surviving. If the 1854 report indicates that a bank closed in 1854, then it is classified as closed. The 1854 report is incomplete and information in the 1855 report is used as well to determine which banks closed in 1854.

Wisconsin

The data on the number of banks are from: 1. House Documents, U.S. Congress, 1853-1863; 2. Rolnick and Weber (1982); and 3. Krueger (1933). Data on the banks' balance sheets are from the bank commissioner's report published in House Document No. 77, 36th Congress, 2nd Session, (January 1861). The bonds included in banks' balance sheets that declined in value are assumed to be the bonds issued by Southern and Border states. If a bank appears in the January 1861 report and in the 1862 report as well, it is classified as surviving. The report for 1862 indicates most of the banks that closed. This information is supplemented by data from Rolnick and Weber (1984).

Annual House Documents Consulted

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U.S. Congress, House Document 227, 25th Congress, 3rd Session (1839).
U.S. Congress, House Document 172, 26th Congress, 1st Session (1840).
U.S. Congress, House Document 111, 26th Congress, 2nd Session (1841).
U.S. Congress, House Document 226, 29th Congress, 1st Session (1846).
U.S. Congress, House Document 120, 29th Congress, 2nd Session (1847).
U.S. Congress, House Document 77, 30th Congress, 1st Session (1848).
U.S. Congress, House Document 68, 31st Congress, 1st Session (1850).
U.S. Congress, House Document 122, 32nd Congress, 1st Session (1852).
U.S. Congress, House Document 66, 32nd Congress, 2nd Session (1853).
U.S. Congress, House Document 102, 33rd Congress, 1st Session (1854).
U.S. Congress, House Document 82, 33rd Congress, 2nd Session (1855).
U.S. Congress, House Document 102, 34th Congress, 1st Session (1856).
U.S. Congress, House Document 87, 34th Congress, 3rd Session (1857).
U.S. Congress, House Document 107, 35th Congress, 1st Session (1858).
U.S. Congress, House Document 112, 35th Congress, 2nd Session (1859).
U.S. Congress, House Document 49, 36th Congress, 1st Session (1860).
U.S. Congress, House Document 77, 36th Congress, 2nd Session (1861).
U.S. Congress, House Document 25, 37th Congress, 3rd Session (1862).

B. Non-Banking Variables

Distance to Redemption Center

The distance to a redemption center is measured as the straight-line distance from the city or town where a bank was located to the nearest city or town in which the state banking authority was located or in which the bank was required to have a redemption agent.

Population

The population data for New York in the 1840s are from the Compendium of the Enumeration of the Inhabitants and Statistics of the United States, Washington 1841. The population data for New York and Indiana in the 1850s are from the Seventh Census of the United States, 1850. The population data for Wisconsin for the 1860s are from the Eighth Census of the United States, 1860.

Square Miles

The areas of counties are not available in the 19th Century censuses and first appear in the Fourteenth Census of the United States, 1920, from which the data are taken.

Bond Prices

All of the data on bond prices except for the prices of Indiana 5s in 1852 are from various issues of Banker's Magazine. The prices of Indiana 5s in 1852 are from Hunt's Merchants' Magazine (May 1853, pp. 611-12).

Table 1
Number of Free Banks and Number Closed
in Selected States

State Period	Total number of free banks opened	Total number of free banks closed	Percent of banks closed
New York 1838-1862	446	157	35.2%
Indiana 1852-1862	104	86	82.7
Wisconsin 1853-1862	140	78	55.7

Sources: See the Data Appendix.

Table 2

Number of Free Banks

Year	NEW YORK Number of Banks Entering	NEW YORK Number of Banks Closing	NEW YORK Number of Banks (Year End)	INDIANA Number of Banks Entering	INDIANA Number of Banks Closing	INDIANA Number of Banks (Year-End)	WISCONSIN Number of Banks Entering	WISCONSIN Number of Banks Closing	WISCONSIN Number of Banks (Year End)
1838	23	0	23						
1839	55	1	77						
1840	4	4	77						
1841	2	13	66						
1842	4	12	57						
1843	9	4	63						
1844	16	8	71						
1845	4	0	75						
1846	3	2	76						
1847	18	0	94						
1848	12	0	106						
1849	11	3	114						
1850	24	3	135						
1851	12	8	139						
1852	45	9	175	15	0	15			
1853	80	22	233	43	28	30	8	0	8
1854	16	13	236	35	27	38	3	1	10
1855	17	12	241	1	6	33	17	3	24
1856	32	7	266	3	3	33	13	2	35
1857	13	15	264	3	18	18	21	6	50
1858	4	2	266	3	3	18	28	3	75
1859	7	1	272	0	0	18	31	7	99
1860	11	6	277	0	1	17	11	3	107
1861	8	11	274	1	0	18	3	50	60
1862	16	1	289	0	0	18	5	3	62

Table 3
T-Accounts to Illustrate Organizing a Bank
(Thousands of dollars)

Sound Bank

Assets		Liabilities	
Bonds	$10	Notes	$10
Specie	1		
Loans	9	Equity	10
Total	$20	Total	$20

Leveraged Bank

Assets		Liabilities	
Bonds	$20	Notes	$20
Specie	2		
Loans	18		
to owner	9		
to others	9	Equity	20
Total	$40	Total	$40

Wildcat Bank

Assets		Liabilities	
Bonds (par)	$20	Notes	$20
market	10	Equity	20
Specie	2	owners' funds	10
Loans	18	one-time-gain	10
Total	$40	Total	$40

Table 4

Estimated Logit Equations

Intercept		Declining bonds relative to capital		Episode Logarithm of Distance to redemption center		Dummy Variable for another bank closing in the county		Equation	
coef sd	msl	coef sd	mp msl	coef sd	mp msl	coef sd	mp msl	Chi-sq mslc	N -2lnL
				New York 1841-42					
-5.127		-.528	-.058	.832	.661	4.023	.227	34.15	71
1.623	.001	1.009	.600	.315	.008	1.133	.000	.000	55.29
				New York 1854					
-4.806		na		.407	.317	1.090	.088	6.10	216
1.090	.000			.221	.065	.577	.059	.047	97.59
				Indiana 1854					
-3.465		.676	.103	.618	.564	2.780	.250	10.52	29
3.181	.268	.890	.447	.698	.375	1.185	.019	.014	27.97
				Wisconsin 1861					
-5.165		1.639	.249	.942	.842	.715	.100	34.04	109
1.346	.000	.704	.019	.305	.002	.465	.124	.000	116.98
				States with data on bonds					
-3.927		.588	.119	.804	.143	1.860	.203	62.94	209
.753	.000	.158	.000	.456	.078	.333	.000	.000	224.68

The symbols are: coef is the estimated coefficient; sd is the estimated standard deviation of the coefficient; mp is the marginal probability of a the variable; msl is the marginal significance level of the Wald statistic of a variable; Chi-sq is the likelihood ratio test statistic asymptotically distributed Chi-square for testing the hypothesis that the estimated coefficients of all variables other than the constant term are zero; mslc is the marginal significance level of the Chi-square test statistic; N is the number of observations; -2lnL is -2 times the logarithm of the likelihood function; and na means the data for the variable is not available.

Table 5

Estimated Effects of Another Bank Closing in the County

Episode	Probability a bank closes if another bank in the county closes	Probability a bank closes if no other bank in the county closes	Change in probability[a]
New York 1841-42	.873	.109	.764
New York 1854	.099	.035	.063
Indiana 1854	.916	.402	.513
Wisconsin 1861	.505	.333	.172

a. Because of rounding, the change in probability does not necessarily exactly equal the difference.

Figure 1
United States and Indiana Bonds
1850 to 1857

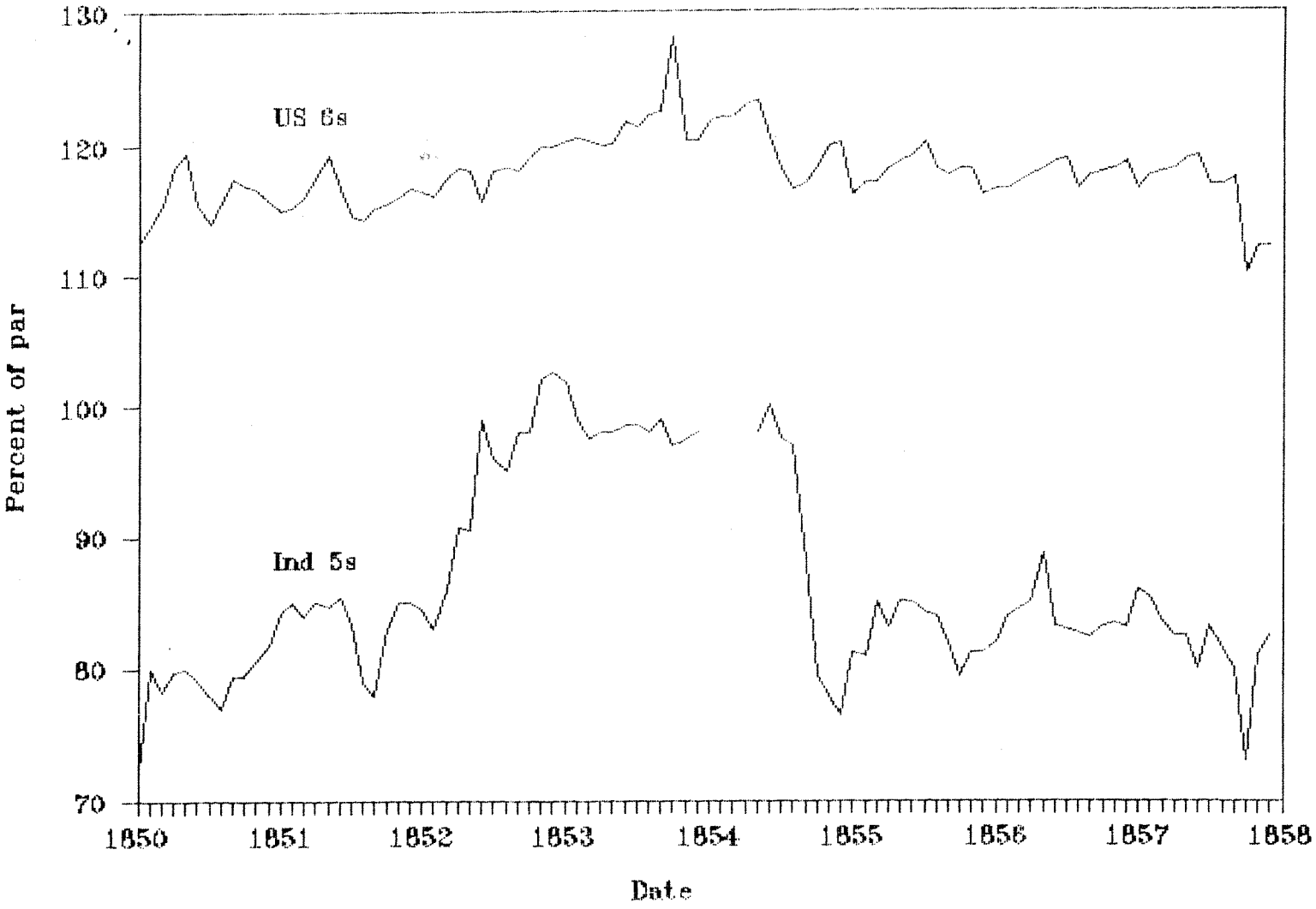

FIGURE 2

BOND PRICES
DECEMBER 1858 TO APRIL 1862